Institute of Freshwater Ecology

Ecological assessment of Loch Lomond water management proposals (Botany)

Part of ITE report to Central Scotland Water Development Board

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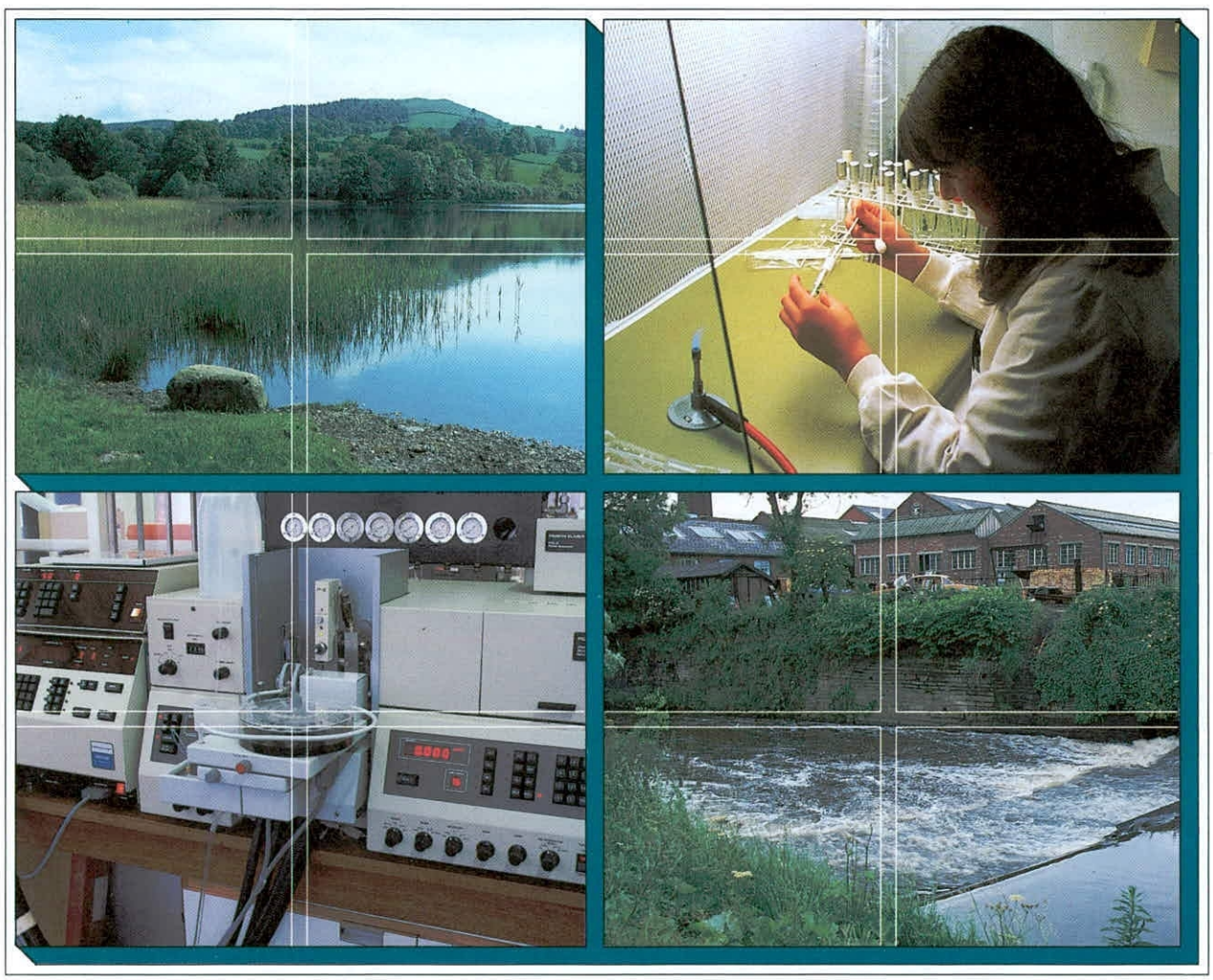

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Project leader:	F H Dawson
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4. RESOURCE INVENTORY

4.6 Vegetation

4.6.1 Introduction

A detailed vegetation survey was conducted for the stretch of the River Leven where dredging is proposed. This involved a full inventory of the plants present in each habitat, with notes on the dominant vegetation types, *etc.* The vascular plants were identified to specific level where possible, using the two standard current British Floras (Clapham *et al.*, 1987; Stace, 1991). Specialised texts were employed for the identification of ferns and allied plants (Jermy & Camus, 1991) and grasses (Hubbard, 1984).

Walk-over surveys of the reaches of the River Leven upstream and downstream of the proposed dredging zone were also conducted, to note any vegetational differences. The dominant plants of Loch Lomond were ascertained by reviewing the literature: publications on the flora of the Loch include Spence (1964), Idle (1974), Tippet (1974), Bailey-Watts & Duncan (1981) and Murphy *et al.* (1992).

Various chemical parameters were also studied to ascertain their impact on the vegetation. Water samples were collected at six sites for subsequent laboratory analysis (Table 1, Fig. 1). The sites were selected to complement the sites used for invertebrate sampling (see section ■ ■ ■ of this report) and the sites selected for water chemical analysis by the Clyde River Purification Board (sites 2, 5, 6, 7 and 8 in Table 1). The chemical analysis included the following parameters: pH; electrolytic conductivity; calcium carbonate ($CaCO_3$) levels; the concentrations of seven different anions (alkalinity, chloride, nitrite, nitrate, phosphate, silicate and sulphate) and four different cations (calcium, magnesium, sodium and potassium); and the resultant ion balance. This data was complemented by on-site determination of dissolved oxygen levels, using a Winkler titration kit.

4.6.2 Water quality

The results of the water chemical analyses conducted by the Institute of Freshwater Ecology are presented as Table 2. The results are in broad agreement with the average values obtained over the previous ten years (1982-91) by the Clyde River Purification Board (Table 3). The water quality is generally high, as would be expected with water immediately flowing from Loch Lomond. High levels of nitrates (NO_3^-) and phosphates (PO_4^{2-}) are generally typical of rivers that are either receiving runoff from agricultural land where fertiliser is applied, or else are receiving sewage effluent. The water of the River Leven has comparatively low levels of both nitrates (< 0.14 mg l^{-1}) and phosphates (4.9-11.4 μl l^{-1}) (Table 2).

The two southernmost sampling sites selected by the Clyde River Purification Board (sites 7 and 8) are tidally influenced. This is corroborated by the high electrolytic conductivity values observed (529.7 and 1771.4 μs cm^{-1} respectively) and high concentrations of chloride ions (178.5 and 652.5 mg l^{-1} respectively) (Table 3).

4.6.3 Woodland communities

Information concerning the structure and composition of woodland communities around Loch Lomond is provided in Idle (1974). There is seemingly little 'natural' deciduous woodland remaining, although there is some on the eastern bank. The most common woodland community consists of oak, growing on thin acidic soils. The dominant oak species of these sites would typically be *Quercus petraea* (Mattuschka) Liebl. (sessile oak); considerable numbers of the common or pedunculate oak (*Q. robur* L.) were planted during major reafforestation during the eighteenth century, however. There has consequently been considerable hybridisation between the two species, and few individuals are pure representatives of *Q. petraea*. The presence of grazing animals such as sheep, deer and cattle has largely prevented the development of diverse shrub vegetation. Where grazers are absent, however, the oak woodlands typically include the following shrubby species: *Ilex aquifolium* L. (holly), *Sorbus aucuparia* L. (rowan) and *Betula pubescens* Ehrh. (downy birch). The ground flora also typically includes: *Vaccinium myrtillus* L. (bilberry), *Deschampsia flexuosa* (L.) Trin. (wavy hair-grass), *Lonicera periclymenum* L. (honeysuckle), *Melampyrum pratense* L. (common cow-wheat), *Galium saxatile* L. (heath bedstraw), and occasionally *Calluna vulgaris* (L.) Hull (ling).

Areas with less acidic soils are typically dominated by both birch (*Betula pubescens*) and oak (*Quercus petraea*, *Q. robur* and hybrids), with a shrub community that often includes hazel (*Corylus avellana* L.). Some areas are richer in minerals; the typical canopy trees include wych elm (*Ulmus glabra* Hudson), ash (*Fraxinus excelsior* L.) as well as oaks. Thickets in these woodlands consist of hazel, hawthorn (*Crataegus monogyna* Jacq.), blackthorn (*Prunus spinosa* L.), bird cherry (*P. padus* L.) and wild cherry (*P. avium* (L.) L.).

In areas with a high water content in the soil, including the loch margin, the oak woodlands are often replaced by alder (*Alnus glutinosa* (L.) Gaertner). Other, small woodland areas around the loch are dominated by aspen (*Populus tremula* L.), willows (*Salix* L. spp.) or yew (*Taxus baccata* L.).

The arboreal flora of the banks of the banks of the River Leven includes many of the species occurring around Loch Lomond, *viz.* alder, hazel, ash, common or pedunculate oak, and willows. The following tree species were also observed: *Acer pseudoplatanus* L. (sycamore), *Fagus sylvatica* L. (beech), *Sambucus nigra* L. (elder) and *Ulmus minor* Miller (elm).

4.6.4 Loch Lomond aquatic and riparian communities

A list of the typical dominant species of aquatic and riparian plants of Loch Lomond is presented in Table 4. This list has been compiled from surveys conducted by Spence (1964), Idle (unpublished surveys of 1967, subsequently outlined in Bailey-Watts & Duncan, 1981), and Murphy *et al.* (1992).

The most recent analytical study of the flora of Loch Lomond is by Murphy *et al.* (1992), who conducted TWINSPAN computer analysis of the vegetational data. This enabled the identification of three main euhydrophytic community types:

(1) A deep water community indicated by the presence of *Elodea canadensis* Michx. (Canadian pondweed), *Myriophyllum alterniflorum* DC. (alternate-flowered water-milfoil) and *Isoetes lacustris* L. (quillwort). *E. canadensis* was not observed by Idle in 1967 (Bailey-Watts & Duncan, 1981); this community is therefore regarded as being a fairly recent development, following the invasive spread of the species in the British Isles.

(2) A community indicated by the presence of charophytes, especially *Nitella flexilis* (L.) Agardh.

(3) A community in sheltered bays, indicated by the presence of *Callitriche hamulata* Kütz. ex Koch (starwort).

In addition to the above three aquatic community types, six different emergent and wetland plant communities were also identified by Murphy *et al.* (1992):

(1) Alluvial silt and mud flats, with *Littorella uniflora* (L.) Ascherson (shore-weed). The nationally rare species *Elatine hydropiper* L. (eight-stamened waterwort) is also found in this community type.

(2) Periodically inundated boulder and gravel shores, with *Myrica gale* L. (bog myrtle) and *Carex* L. spp. (sedges).

(3) Low lying valley bog, dominated by *Molinia caerulea* (L.) Moench. (purple moor-grass), *Myrica gale* and *Sphagnum* L. spp., with *Eleogiton fluitans* (L.) Link (floating club-rush) in pools and old drainage ditches.

(4) Sheltered hinterland waters with *Carex* spp. (sedges), including *C. rostrata* Stokes (beaked sedge).

(5) Fen and fen meadow, again dominated by sedges.

(6) Flood plain alluvial woodland dominated by alder (*Alnus glutinosa*) and willow (*Salix* spp.) carr, with birch (*Betula pubescens*) and oak (*Quercus* spp.) on drier ground (see section 4.6.3 for further detail).

4.6.5 River Leven aquatic and riparian communities

The flora of the zone of the River Leven selected for the proposed dredging operations is typical of the northern reaches of the river generally. Species inventories are presented in Table 5 (aquatic vegetation) and 6 (riparian vegetation).

The aquatic flora is very sparse, with many areas lacking any vegetation other than mosses and algae. Many marginal areas are dominated by *Myriophyllum alterniflorum* DC. (alternate-flowered water-milfoil), *Ranunculus aquatilis* L. (common water-crowfoot), or occasionally *Potamogeton gramineus* L. (various-leaved pondweed).

The marginal vegetation is severely limited by the extent to which the natural banks have been replaced by vertical concrete or stone walls. A considerable degree of silting has occurred adjacent to the banks, however; these areas support communities dominated by

rushes (*Juncus* L. spp.), reed-grass (*Phalaris arundinacea* L.) and various other grasses. Although several arboreal species were observed on the right bank, these were only saplings. The left bank, however, is heavily shaded by numerous mature trees; these species are discussed further in section 4.6.3.

5. POSSIBLE EFFECTS OF THE DEVELOPMENT

5.4 Impacts on vegetation structure and composition

The banks of the River Leven have been greatly altered by human activity, with extensive lengths of both banks, including the proposed dredging zone, artificially reconstructed. As a consequence, the riparian vegetation is restricted in both size and diversity, with no rare plants observed.

The substrate of the river is largely composed of stones, with little silt. This has restricted the development of the aquatic vegetation, and most plant stands are restricted to the slower flowing marginal areas. As with the riparian vegetation, no rare plants were observed during the surveys. The long term impacts on the vegetation are therefore not serious.

The immediate impact of dredging on the aquatic environment would be a marked increase in turbidity (suspended solids) downstream. This can affect aquatic plants by reducing light penetration in the water, which would consequently reduce photosynthetic rates, and hence reduce dissolved oxygen levels. The oxygen would also be depleted by the respiration of suspended organic matter as it passes downstream. The settlement of suspended particles would also affect the survival of aquatic plants by clogging respiratory surfaces.

6. MINIMISING IMPACTS

6.3 Reducing effects on vegetation

The deleterious effect that increased levels of suspended solids can have on the downstream biota have been outlined in section 5.4. It is important that these effects are minimised by restricting the periods of continual dredging: it is recommended that work is intermittent, with frequent breaks to allow suspended solid levels to fall occasionally.

Monitoring of downstream turbidity and dissolved oxygen levels during dredging can enable some feedback to moderate the work rate and reduce the potential impact on the ecosystem. The Institute of Freshwater Ecology is able to achieve this by means of field-based computerised data logging equipment with the necessary probes suspended in the water. This should not only protect the Central Scotland Water Development Board against possible claims for compensation, but would also ensure that their environmental policy is being demonstratably shown.

Table 1. Sites on Loch Lomond and River Leven selected for analysis of water chemistry. The six sites sampled by the Institute of Freshwater Ecology (sites 1-6) are indicated on Fig. 1. CRPB = Clyde River Purification Board; IFE = Institute of Freshwater Ecology.

Site	National Grid Reference	Organisation conducting analysis
1. Loch Lomond	NS 385824	IFE
2. Balloch Bridge	NS 391819	IFE & CRPB
3. Dredging zone (upstream)	NS 394813	IFE
4. Dredging zone (downstream)	NS 396808	IFE
5. Bonhill Bridge	NS 396798	IFE & CRPB
6. Renton	NS 390785	IFE & CRPB
7. Dalmoak Pumping Station (downstream)	NS 39?76?	CRPB
8. Dumbarton	NS 39?75?	CRPB

Table 2. Results of water chemical analyses conducted by the Institute of Freshwater Ecology. Samples collected between 21-22nd July 1992. Site codes 1-6 as in Table 1 and Fig. 1. n/d = not detectable.

	Sampling site					
	1	2	3	4	5	6
Dissolved oxygen (%)	100.4	100.2	100.0	99.3	101.7	101.0
pH	7.03	6.32	6.67	6.97	8.30	6.78
Conductivity (μs cm^{-1})	72	58	101	92	64	72
Calcium carbonate, $CaCO_3$ (mg l^{-1})	17.5	12.5	30.5	25.5	11.5	12.5
Anions						
Alkalinity, HCO_3^- (m.e.l.)	0.35	0.25	0.61	0.51	0.23	0.25
Chloride, Cl^- (mg l^{-1})	4.96	9.22	2.48	6.73	7.09	9.22
Nitrite, NO_2^- (μg l^{-1})	6.44	6.49	5.78	19.7	6.08	7.35
Nitrate, NO_3^- (mg l^{-1})	0.10	0.13	n/d	0.04	0.09	0.14
Phosphate, PO_4^{2-} (μg l^{-1})	11.4	5.31	5.71	5.31	5.31	4.90
Silicate, SiO_3^{2-} (mg l^{-1})	0.32	0.28	0.55	0.37	0.26	0.32
Sulphate, SO_4^{2-} (mg l^{-1})	13.4	7.68	11.5	6.72	7.68	7.68
Cations						
Calcium, Ca^{2+} (mg l^{-1})	9.6	6.8	15.2	13.2	6.8	6.4
Magnesium, Mg^{2+} (mg l^{-1})	1.16	0.92	1.15	1.19	0.99	1.07
Sodium, Na^+ (mg l^{-1})	4.4	4.0	4.8	4.4	4.6	4.5
Potassium, K^+ (mg l^{-1})	0.50	0.45	0.54	0.47	0.48	0.49
Ion balance (m.e.l.)	0.77: 0.78	0.67: 0.60	0.92: 1.07	0.84: 0.96	0.59: 0.63	0.67: 0.62

Table 3. Results of water chemical analyses conducted by the Clyde River Purification Board. The values are averages over the previous ten years (1982-1991). Site codes 2 and 5-8 as in Table 1.

	Sampling site				
	2	5	6	7	8
Dissolved oxygen (%)	94.8	95.5	96.3	96.9	93.2
pH	7.07	7.14	7.08	7.08	7.09
Conductivity ($\mu s\ cm^{-1}$)	66.5	67.2	71.2	529.7	1771.4
Total hardness, $CaCO_3 + MgCO_3$ ($mg\ l^{-1}$)	21.4	22.6	24.1	73.5	222.8
Anions					
Alkalinity, HCO_3^- (m.e.l.)	13.5	14.0	15.0	16.7	20.5
Chloride, Cl^- ($mg\ l^{-1}$)	8.3	8.8	9.8	178.5	652.5
Nitrite, NO_2^- ($\mu g\ l^{-1}$)	5.1	4.8	5.0	6.1	8.9
Nitrate, NO_3^- ($mg\ l^{-1}$)	0.29	0.29	0.30	0.29	0.31
Phosphate, PO_4^{2-} ($\mu g\ l^{-1}$)	10.5	5.8	6.7	12.0	14.6
Ammonia, NH_3 ($mg\ l^{-1}$)	0.024	0.024	0.026	0.027	0.057

Table 4. List of aquatic and riparian plant species of Loch Lomond, derived from surveys by Spence (1964), Idle (published in Bailey-Watts & Duncan, 1981) and Murphy *et al.* (1992).

Alnus glutinosa (L.) Gaertner (Betulaceae)	Alder
Callitriche hamulata Kütz. ex Koch (Callitrichaceae)	Starwort
Caltha palustris L. (Ranunculaceae)	Kingcup, Marsh Marigold, May Blobs
Carex acutiformis Ehrh. (Cyperaceae)	Lesser Pond-sedge
Carex nigra (L.) Reichard (Cyperaceae)	Common Sedge
Carex rostrata Stokes (Cyperaceae)	Beaked Sedge, Bottle Sedge
Carex vesicaria L. (Cyperaceae)	Bladder Sedge
Carum verticillatum (L.) Koch (Umbelliferae)	Whorled Caraway
Deschampsia cespitosa (L.) Beauv. (Gramineae)	Tufted Hair-grass
Elatine hydropiper L. (Elatinaceae)	Eight-stamened Waterwort
Eleocharis acicularis (L.) Roemer et Schultes (Cyperaceae)	Needle Spike-rush
Eleocharis palustris (L.) Roemer et Schultes (Cyperaceae)	Common Spike-rush
Eleogiton fluitans (L.) Link (Cyperaceae)	Floating Club-rush
Elodea canadensis Michx. (Hydrocharitaceae)	Canadian Pondweed
Equisetum fluviatile L. (Equisetaceae)	Water Horsetail
Fontinalis antipyretica Hedw. (Fontinalaceae)	Moss
Glyceria fluitans (L.) R. Br. (Gramineae)	Floating Sweet-grass, Flote-grass
Filipendula ulmaria (L.) Maxim. (Rosaceae)	Meadowsweet
Hydrocotyle vulgaris L. (Umbelliferae)	Marsh Pennywort, White-rot
Isoetes lacustris L. (Isoetaceae)	Quillwort
Juncus acutiformis Ehrh. ex Hoffm. (Juncaceae)	Sharp-flowered Rush
Juncus articulatus L. (Juncaceae)	Jointed Rush
Juncus bufonius group (Juncaceae)	Toad Rush
Littorella uniflora (L.) Ascherson (Plantaginaceae)	Shore-weed
Lobelia dortmanna L. (Campanulaceae)	Water Lobelia
Molinia caerulea (L.) Moench. (Gramineae)	Purple Moor-grass
Myosotis scorpioides L. (Boraginaceae)	Water Forget-me-not
Myrica gale L. (Myricaceae)	Bog Myrtle, Sweet Gale
Myriophyllum alterniflorum DC. (Haloragidaceae)	Alternate-flowered Water-milfoil
Nitella flexilis (L.) Agardh [synonym: *N. opaca* (Bruz.) Agardh] (Characeae)	Charophyte
Nuphar lutea (L.) Sm. (Nymphaeaceae)	Yellow Water-lily, Brandy-bottle
Phalaris arundinacea L. (Gramineae)	Reed-grass
Polygonum amphibium L. (Polygonaceae)	Amphibious Bistort
Polygonum hydropiper L. (Polygonaceae)	Water-pepper
Potamogeton crispus L. (Potamogetonaceae)	Curled Pondweed
Potamogeton × *nitens* Weber (Potamogetonaceae)	-
Potamogeton obtusifolius Mert. et Koch (Potamogetonaceae)	Grassy Pondweed
Potamogeton perfoliatus L. (Potamogetonaceae)	Perfoliate Pondweed
Ranunculus flammula L. (Ranunculaceae)	Lesser Spearwort
Ranunculus aquatilis L. (Ranunculaceae)	Common Water-crowfoot
Salix c.f. *cinerea* L. subsp. *oleifolia* Macreight [synonym: *S.* c.f. *atrocinerea* Brot.] (Salicaceae)	Rusty Sallow
Schoenoplectus lacustris (L.) Palla (Cyperaceae)	Bulrush
Sphagnum L. sp. (Sphagnaceae)	Sphagnum
Veronica scutellata L. (Scrophulariaceae)	Marsh Speedwell

Table 5. List of aquatic vascular plant species in the reach of River Leven for proposed dredging.

Elodea canadensis Michx. (Hydrocharitaceae)	Canadian Pondweed
Myriophyllum alterniflorum DC. (Haloragidaceae)	Alternate-flowered Water-milfoil
Potamogeton gramineus L. (Potamogetonaceae)	Various-leaved Pondweed
Ranunculus aquatilis L. (Ranunculaceae)	Common Water-crowfoot

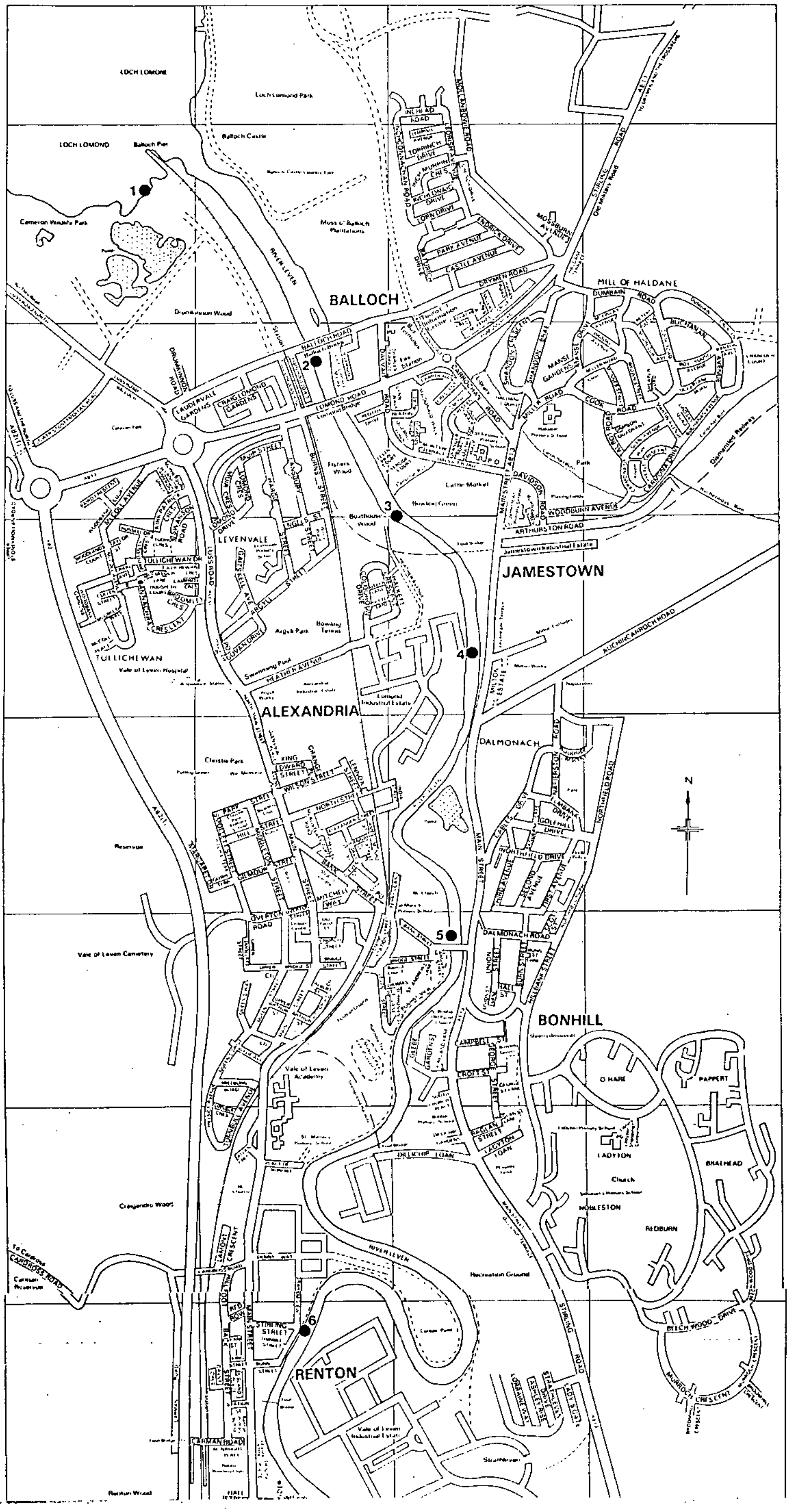
Table 6. List of riparian vascular plant species present on the reach of River Leven for proposed dredging. [L] = recorded on left bank only; [R] = recorded on right bank only.

Acer pseudoplatanus L. (Aceraceae)	Sycamore
Achillea millefolium L. (Compositae) [R]	Yarrow, Milfoil
Achillea ptarmica L. (Compositae) [R]	Sneezewort
Agrostis capillaris L. [synonym: *A. tenuis* Sibth.] (Gramineae) [R]	Common Bent-grass
Alisma plantago-aquatica L. (Alismataceae) [R]	Water-plantain
Alnus glutinosa (L.) Gaertner (Betulaceae) [L]	Alder
Anthoxanthum odoratum L. (Gramineae) [R]	Sweet Vernal-grass
Anthriscus sylvestris (L.) Hoffm. (Umbelliferae) [R]	Cow Parsley, Keck
Athyrium filix-femina (L.) Roth (Athyriaceae)	Lady Fern
Calystegia sepium (L.) R. Br. (Convolvulaceae) [L]	Belbine, Hedge Bindweed
Centaurea nigra L. (Compositae)	Lesser Knapweed, Hardheads
Chamaenerion angustifolium (L.) Scop. [synonyms: *Epilobium angustifolium* L., *Chamerion angustifolium* (L.) J. Holub] (Onagraceae)	Rosebay Willow-herb, Fireweed
Corylus avellana L. (Corylaceae) [R]	Hazel, Cob-nut
Crataegus monogyna Jacq. (Rosaceae) [L]	Hawthorn
Dactylis glomerata L. (Gramineae)	Cock's-foot
Digitalis purpurea L. (Scrophulariaceae) [L]	Foxglove
Dryopteris affinis (Lowe) Fraser-Jenkins complex (Aspidiaceae) [R]	Scaly Male-fern
Eleocharis palustris (L.) Roemer et Schultes (Cyperaceae) [R]	Common Spike-rush
Epilobium palustre L. (Onagraceae) [R]	Marsh Willow-herb
Equisetum fluviatile L. (Equisetaceae)	Water Horsetail
Fagus sylvatica L. (Fagaceae) [L]	Beech
Filipendula ulmaria (L.) Maxim. (Rosaceae)	Meadowsweet
Fraxinus excelsior L. (Oleaceae)	Ash
Galium palustre L. (Rubiaceae) [R]	Lesser Marsh Bedstraw
Hedera helix L. (Araliaceae) [L]	Ivy
Hieracium L. sp. (Compositae) [L]	Hawkweed
Holcus mollis L. (Gramineae) [R]	Creeping Soft-grass
Hypericum perforatum L. (Hypericaceae)	Perforate St John's-wort
Iris pseudacorus L. (Iridaceae) [L]	Yellow Iris, Yellow Flag
Juncus acutiformis Ehrh. ex Hoffm. (Juncaceae) [R]	Sharp-flowered Rush
Juncus bufonius group (Juncaceae) [L]	Toad Rush
Juncus effusus L. var. *subglomeratus* DC. [synonym: *J. effusus* var. *compactus* Lej. et Courtois] (Juncaceae) [L]	Soft Rush
Lolium perenne L. (Gramineae) [R]	Rye-grass, Ray-grass
Mentha aquatica L. (Labiatae) [R]	Water Mint
Nasturtium officinale R. Br. [synonym: *Rorippa nasturtium-aquaticum* (L.) Hayek] (Cruciferae) [L]	Green Water-cress, Summer Water-cress
Oenanthe crocata L. (Umbelliferae)	Hemlock Water-dropwort
Phalaris arundinacea L. (Gramineae)	Reed-grass
Plantago L. sp. (Plantaginaceae) [R]	Plantain
Polygonum L. sp. (Polygonaceae) [R]	Knotgrass, Bistort
Polygonum amphibium L. (Polygonaceae) [L]	Amphibious Bistort
Potentilla palustris (L.) Scop. (Rosaceae)	Marsh Cinquefoil
Quercus robur L. (Fagaceae) [L]	Common Oak, Pedunculate Oak

Table 6 (cont.).

Ranunculus repens L. (Ranunculaceae)	Creeping buttercup
Rosa L. sp. (Rosaceae) [R]	Wild Rose
Rubus fruticosus sensu lato (Rosaceae)	Blackberry, Bramble
Rubus idaeus L. (Rosaceae) [L]	Raspberry
Rumex L. sp. (Polygonaceae)	Dock, Sorrel
Salix L. spp. (Salicaceae) [L]	Willow
Sambucus nigra L. (Caprifoliaceae) [R]	Elder
Senecio jacobaea L. (Compositae)	Ragwort
Taraxacum officinale Wigg. group (Compositae) [R]	Dandelion
Trifolium pratense L. (Leguminosae) [R]	Red Clover
Ulmus minor Miller (Ulmaceae) [L]	Elm
Urtica dioica L. (Urticaceae)	Common Nettle, Stinging Nettle
Valeriana officinalis L. (Valerianaceae)	Common Valerian
Vicia cracca L. (Leguminosae)	Tufted Vetch

Figure 1. Map of River Leven and southern tip of Loch Lomond, illustrating sites selected for water chemical analysis by the Institute of Freshwater Ecology.


LOCH LOMOND
Loch Lomond Park
Balloch Castle
Balloch Pier
Cameron Wildlife Park
Drumkinnon Wood
BALLOCH
BALLOCH ROAD
LOMOND ROAD
DRYMEN ROAD
PARK AVENUE
CASTLE AVENUE
LORN DRIVE
INCHEAD ROAD
TORRINCH DRIVE
MOSSBURN AVENUE
STIRLING ROAD
MILL OF HALDANE
DUMBAIN ROAD
BUCHANAN
MANSE GARDENS
COOK ROAD
CARROCHAN ROAD
LAUDERVALE GARDENS
CRAIGLOMOND GARDENS
DRUMMOND ROAD
Dismantled Railway
Cattle Market
Bowling Green
DAVIDSON ROAD
WOODBURN AVENUE
ARTHURSTON ROAD
Jamestown Industrial Estate
JAMESTOWN
AUCHINCARROCH ROAD
Fishers Wood
Boathouse Wood
LEVENVALE
ARGYLL STREET
Argyll Park
Swimming Pool
HEATHER AVENUE
TULLICHEWAN
Vale of Leven Hospital
LUSS ROAD
Lomond Industrial Estate
ALEXANDRIA
DALMONACH
Christie Park
KING EDWARD STREET
GRANGE STREET
WILSON STREET
NORTH STREET
LENNOX STREET
GILMOUR STREET
BANK STREET
MITCHELL WAY
MAIN STREET
NORTHFIELD DRIVE
GOLFHILL DRIVE
DALMONACH ROAD
Reservoir
OVERTOUN ROAD
Vale of Leven Cemetery
BONHILL
CAMPBELL ST
CROFT ST
GLEBE GARDENS
Vale of Leven Academy
DILLICHIP LOAN
LADYTON LOAN
O HARE
PAPPERT
LADYTON
Church
BRAEHEAD
NOBLESTON
REDBURN
RIVER LEVEN
Recreation Ground
BEECHWOOD DRIVE
MURROCH CRESCENT
To Cardross
CARDROSS ROAD
STIRLING STREET
RENTON
CARMAN ROAD
Vale of Leven Industrial Estate
Strathleven
Renton Wood
N
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9. REFERENCES

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